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HOOVERIA, A NEW GENUS LIBERATED FROM *CHLOROGALUM* (AGAVACEAE SUBF. CHLOROGALOIDEAE)

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ABSTRACT

Molecular phylogenetic analyses have indicated that *Chlorogalum* (sensu lato) (Agavaceae subf. Chlorogaloideae) comprises more than one lineage. A recently published study indicated that *Chlorogalum* is paraphyletic, with two well-supported clades that are successive sister groups to the remainder of the Chlorogaloideae. The first is composed of three vespertine-flowering species (*Chlorogalum* sensu stricto), and the second comprises two diurnally flowering species. Additional morphological and cytological evidence independently support recognition of two lineages. **Hooveria**, **gen. nov.**, is proposed to accommodate the diurnally flowering species of the second lineage. Three taxa are transferred from *Chlorogalum* to the new genus: **Hooveria parviflora** (S. Wats.) D.W. Taylor & D.J. Keil, **comb. nov.**, **H. purpurea** (Brandeg.) D.W. Taylor & D.J. Keil, **comb. nov.**, and **H. purpurea** var. **reducta** (Hoover) D.W. Taylor & D.J. Keil, **comb. nov.** A neotype is designated for *Chlorogalum parviflorum* S. Wats.

Chlorogalum Kunth (Agavaceae subf. Chlorogaloideae) as treated traditionally is a genus of five species with nine terminal taxa (Jernstedt 2002; Callahan 2015a, b; Table 1). *Chlorogalum* is endemic to the California Floristic Province, extending from its northern limit in southern Coos County, Oregon (Callahan 2015b), southward to extreme northwestern Baja California (Rebman et al. 2016). Four of the nine taxa are considered to be rare and endangered (California Native Plant Society 2018).

Table 1. Taxa of *Chlorogalum* (sensu lato) with their flowering times and chromosome numbers

Taxon	**Flowering time**	**Chromosome number(s)**
Chlorogalum angustifolium Kellogg	vespertine	$2n = 34$
Chlorogalum grandiflorum Hoover	vespertine	unknown
Chlorogalum parviflorum S. Wats.	diurnal	$2n = 60$
Chlorogalum purpureum Brandeg.		
var. *purpureum*	diurnal	$2n = 60$
var. *reductum* Hoover	diurnal	unknown
Chlorogalum pomeridianum (DC.) Kunth		
var. *divaricatum* (Lindl.) Hoover	vespertine	$2n = 36$
var. *minus* Hoover	vespertine	$2n = 36$
var. *pomeridianum*	vespertine	$2n = 30, 36$
subsp. *austrooreganum* Callahan	vespertine	unknown

In his monograph of *Chlorogalum*, Hoover (1940) presciently discussed the relationships of the taxa included in the genus:

> It is notable that the species are definitely divided into two groups in regard to flowering, three being vespertine and two diurnal. It is evidently no mere coincidence that the two diurnal species, *C. parviflorum* and *C. purpureum*, are also distinguished by having small flowers with the style longer than the perianth. These differences are so correlated with some difference in general aspect that one is led to suspect that the genus as accepted is composed of two separate lines of descent. At any rate, the two groups of species are so much alike morphologically and so close geographically that their inclusion in a single genus is quite consistent with any generally accepted classification of the Liliaceae.

Subsequent studies have added evidence about the differences between the diurnal and vespertine species. Cave (1970) reported that the vespertine species have chromosome numbers ranging from $2n = 30$ to $2n = 36$ and that the two diurnal species have a chromosome number of $2n = 60$ (Table 1). Although the higher numbers might be interpreted as polyploids based on 15 ($2n = 4x = 60$), Cave pointed out that the karyotypes of the two taxa with $2n = 60$ contain five instead of six pairs of large chromosomes [and 25 instead of 24 pairs of smaller chromosomes]. Consequently the $2n = 60$ chromosome numbers cannot be explained by a simple doubling from a $2n = 30$ base, which is consistent with a complex evolutionary history separating the two groups.

Halpin and Fishbein (2013) examined phylogenetic relationships in the Agavaceae subf. Chlorogaloideae based on four chloroplast DNA regions. Their analyses suggested that *Chlorogalum* is not monophyletic. With moderate support their analysis indicated that while the vespertine species form a well-supported clade, the two diurnal species form a basal grade with *C. parvifolium* and *C. purpureum* as successive sister taxa to a clade comprising the vespertine *Chlorogalum* species, *Hastingsia* S. Wats., and *Camassia* Lindl.

Archibald et al. (2015) also used molecular phylogenetic tools to investigate relationships in Agavaceae subf. Chlorogaloideae, plus other Agavaceae. Using two chloroplast regions, ndhF and trnL–trnF, plus nrDNA ITS for phylogenetic inference, they too concluded that *Chlorogalum* is not monophyletic. With strong support their analyses resolved a clade comprising the vespertine species and a second clade comprising the diurnal taxa. Their *Chlorogalum* 2 clade is sister to the remainder of the Chlorogaloideae, which comprises the Chlorogalum 1 clade plus *Hastingsia* and *Camassia*, each of which is resolved as monophyletic. Jenny Archibald (pers. comm. 2018) indicated to us that the authors of the Archibald et al. (2015) study do not plan to propose taxonomic changes based on their study but have no objections to us doing so. We therefore are proposing a new genus to encompass the taxa comprising their *Chlorogalum* 2 clade.

HOOVERIA D.W. Taylor & D.J. Keil, **gen. nov.** **TYPE**: *Chlorogalum purpureum* Brandegee, Zoe 4: 159. 1893. [= *Hooveria purpurea* (Brandegee) D.W. Taylor & D.J. Keil]

Herbaceous perennials from tunicate bulbs. Leaves basal, linear, margins undulate. Inflorescence a panicle; bracts linear, subtending inflorescence branches and flowers; pedicels articulated; flowers diurnal, 1–several per node; perianth white, purple, or pinkish; tepals 6, 5–8 mm, distinct, linear to oblong, recurved, with nectaries at base, persisting in fruit and twisting together distal to capsule; stamens 6, inserted on bases of tepals; anthers versatile; style exserted, exceeding perianth lobes, stigmas 3, minute. Fruit a capsule, 3-valved, dehiscence loculicidal. Seeds 2 per locule or 1 by abortion, black.

HOOVERIA PARVIFLORA (S. Wats.) D.W. Taylor & D.J. Keil, **comb. nov.** *Chlorogalum parviflorum* S. Wats., Proc. Amer. Acad. Arts 14: 243. 1879. **NEOTYPE** (here designated): **USA. California.** San Diego Co.: Cajon Valley, 14 mi. from S. D. [San Diego], May 1878, *D. Cleveland s.n.* (GH 00029896, image!). The original publication cited a collection: "S.

California (Cajon Valley, near San Diego); D. Cleveland, 1877." No specimens of this taxon were found in GH collected by Cleveland in 1877. The label of the 1878 collection bears the notation "*Chlorogalum parviflorum* Watson n. sp." in Watson's handwriting; it is likely that Watson merely cited the wrong date in the original publication, but this cannot be verified. We are therefore designating Cleveland's 1878 collection as neotype for *C. parviflorum*.

HOOVERIA PURPUREA (Brandegee) D.W. Taylor & D.J. Keil, **comb. nov.** *Chlorogalum purpureum* Brandegee, Zoe 4: 159. 1893. **LECTOYPE** (Hoover 1940): **USA. California.** Monterey Co.: near Jolon, 6 Jun 1893, *A. Eastwood s.n.*: (UC 119744, image!; isolectotype, F 0046005F, image!).

HOOVERIA PURPUREA (Brandegee) D. W. Taylor & D.J. Keil var. **PURPUREA**

HOOVERIA PURPUREA (Brandegee) D.W. Taylor & D.J. Keil var. **REDUCTA** (Hoover) D.W. Taylor & D.J. Keil, **comb. nov.** *Chlorogalum purpureum* Brandegee var. *reductum* Hoover, Leafl. W. Bot. 10: 124. 1964. **TYPE**: **USA. California**. San Luis Obispo Co.: 18 miles east of Creston on La Panza Road, 3 May 1957, *R.F. Hoover 8384* (holotype: OBI!; isotypes: CAS456960, image!, K 000802709, image!, UC 1296310, image!).

Etymology. *Hooveria* is named in honor of Robert Francis Hoover (1913–1970), one of California's most able field botanists, student of various groups of lilies, author of *The Vascular Plants of San Luis Obispo County, California* (Hoover 1970), and founder of the herbarium at California Polytechnic State University, which is named in his honor. Commemorating Robert Hoover with this new genus is particularly fitting as his ca. 11,000 numbers contributed a substantial record of the California flora prior to rapid post-WWII population growth. He was among the last persons to record several species now presumed extinct, including *Monardella leucocephala* A. Gray (Lamiaceae), *Plagiobothrys glaber* (Gray) I.M. Johnst., and *Cryptantha hooveri* I.M. Johnst. (Boraginaceae). Hoover is commemorated by several taxa, all of which are endangered to some degree and endemic to the California region (California Native Plant Society 2018): *Agrostis hooveri* Swallen (Poaceae) and *Pleuropogon hooverianus* (L. Benson) J.T. Howell (Poaceae); *Arctostaphylos hooveri* P.V. Wells (Ericaceae); *Eryngium aristulatum* Jeps. var. *hooveri* Sheikh and *Lomatium hooveri* (Mathias & Constance) Constance & Ertter (Apiaceae); *Calycadenia hooveri* G.D. Carr (Asteraceae); *Brodiaea elegans* Hoover subsp. *hooveri* T.F. Niehaus (Themidaceae); *Euphorbia hooveri* L.C. Wheeler (Euphorbiaceae); *Eriastrum hooveri* (Jeps.) H. Mason (Polemoniaceae); and *Cryptantha hooveri* I.M. Johnst. (Boraginaceae). Hoover collected type material or the first known specimens for all of these endemics and for various others.

Geographic distribution. The geographic range of *Hooveria* is disjunct. *Hooveria purpurea* occupies sites in Monterey and San Luis Obispo counties in central California. The type variety occurs in foothill woodland areas of southern Monterey and adjacent northern San Luis Obispo counties, where it is wholly or largely restricted to two military bases: Fort Hunter Liggett in southern Monterey County, and Camp Roberts, which straddles the Monterey-San Luis Obispo county line. *Hooveria purpurea* var. *reducta* (Figs. 1, 2) is restricted to a very small area about 40 miles to the southeast on the Red Hill Mesa and nearby sites in south-central San Luis Obispo County, where it grows on highly weathered, rocky, reddish clay soils in an area of open foothill woodland. It occurs in the Los Padres National Forest and nearby areas of privately owned lands. *Hooveria parviflora* ranges from southeastern Los Angeles and adjacent Riverside counties south through Orange and San Diego counties to extreme northwestern Baja California. It occupies sites in coastal scrub, chaparral, grassland, and open woodlands.

Figure 1. *Hooveria purpurea* var. *reducta*. Rosette in rocky red clay soil, Red Hill Mesa in San Luis Obispo County, California. Photo by David Keil.

Figure 2. *Hooveria purpurea* var. *reducta*. Inflorescence branches with diurnal flowers, Red Hill Mesa in San Luis Obispo County, California. Photo by David Keil.

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